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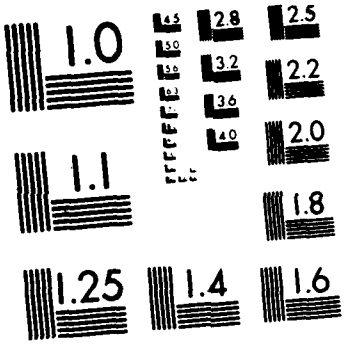

DEPARTMENT OF DEFENSE

STATEMENT ON

THE X-RAY LITHOGRAPHY PROGRAM

BY

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TO

RESEARCH AND DEVELOPMENT
SUBCOMMITTEE OF THE
HOUSE ARMED SERVICES COMMITTEE

100TH CONGRESS, SECOND SESSION

17 MARCH 1988

Mr. Chairman and Members of the Committee

INTRODUCTION

I'm Sonny Maynard, The Director of Computer and Electronics Technology in the Department of Defense. I appreciate the opportunity to put our work in X-RAY Lithography into context within the Department's overall program. I will give a you synopsis of our overall strategies in computer and electronics technology with an emphasis on semiconductors and software. This will be followed by a more detailed description of the X-RAY Lithography.

SEMICONDUCTOR TECHNOLOGY

The Department has a broad and necessarily diverse program in semiconductor science and technology. The three principal goals of that effort are:

- Reduce the gap between commercial integrated circuit usage and its deployment in military systems.
- Assure a healthy on-shore industrial base to support our defense needs.
- Enhance the producibility of specialized military semiconductor products.

The major effort to achieve the first of these objectives is the Very High Speed Integrated Circuits (VHSIC) Program which is nearing completion. Simply stated, in 1980 the gap between commercial and military use of a given level of technology was approaching 10 years. We set out to reduce this in two steps:

1) deploy 1986 technology, characterized by a minimum feature size of 1.25 micrometers by 1991. We will do this in a wide variety of systems. In fact, as Secretary Carlucci has testified, we are ahead of that schedule by deploying it in the F-111 Digital Signal Transfer Unit this year.

2) We are well along on defining the products and developing the insertion tools to put 1990 technology at .5 micrometers minimum feature size into use within 2-4 years of their commercial appearance.

The second goal addresses a problem cited by the Defense Science Board in 1986 which pointed out that the US Semiconductor industry had been impacted by foreign competition which had taken away the US leadership in manufacturing. In FY 1988 monies were appropriated for the Defense Department to work with a consortium , called SEMATECH, made up of US integrated circuit manufacturers and users who represent over 90% of the on-shore manufacturing and customer base for these devices. We are currently working with SEMATECH to achieve a Memorandum of Understanding and Operating Plan. These will be provided in a

report to Congress by the end of this month. They will lay out the plans to recapture world leadership in semiconductor manufacturing and make that technology available to defense electronic users. In addition, we are expanding our effort to develop X-Ray lithography equipment and processes which will put in place a few of the basic tools necessary to establish .25 micrometer processes which are beyond even the planning horizon of SEMATECH.

The third goal is being addressed by two major programs aimed at establishing high yield, low cost fabrication capabilities for sensor technology in the microwave/millimeter wave and infrared regions. The first of these the Microwave/millimeter wave Monolithic Integrated Circuit (MIMIC) program has just completed a study program with 16 teams representing over 40 companies to define the product mix needed to meet military system requirements for radar, electronic warfare, smart weapons and telecommunications. We are currently in source selection to choose a few of these teams to do the proof of principle demonstrations of the fabrication capability needed to make these products affordable. In a manner similar to that which was used on the MIMIC program, we are bringing together the system requirements of all DoD with the device fabrication and product delivery capabilities of industry in an Infrared Focal Plane Array (IRFPA) program. The program is now in the last stages of producing a statement of work for solicitation this year. The IRFPA will establish affordable

product manufacturing capabilities which can meet the production rates demanded by IR sensors for smart weapons, surveillance and target direction systems of the near future.

SOFTWARE ENGINEERING

The goal of the Software Initiative is to enhance our warfighting capability through development of efficient software generation technology and products plus the creation of a technology infusion infrastructure to couple the technology and products to system applications. The program has been underway for four years and consists of three parts: 1) maintenance and support for the Ada language, 2) contracts with industry for the development of automated software production tools, and 3) a Federally funded Research and Development Center called the Software Engineering Institute to work directly with our industrial base to help them rapidly assimulate the technology. The Department has implemented the recommendations of the Defense Science Board and Congress to centralize and consolidate our efforts by combining these three programs into one program element.

X-RAY LITHOGRAPHY

X-Ray lithography is the leading lithography candidate for extending the definition of geometries to 0.25 micrometers; the present approach, using optical wavelengths, is expected to reach practical limits at feature sizes of about 0.35 micrometers, in the ealy 1990's time frame.

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The X-Ray Lithography Program discussed here today will begin to establish the industrial base which will be required to sustain U. S. leadership in the semiconductor industry for the late 1990s. It draws upon an existing base of technology in federal laboratories, industry, and the university community. It addresses technical challenges in key areas, such as x-ray sources (synchrotron and laser plasma), masks, mask-to-wafer alignment equipment, and device fabrication -- all directed at the ultimate goal of semiconductor device production. Further, this production must be timely, with yields competitive in the intense, international arena of integrated circuit production. The technical tasks range from research through manufacturing.

The program is underway now with funding in the FY 1988 budget. Device fabrication with geometries of 0.25 micrometers will be two generations beyond that of DoD's VHSIC program.

It is the expressed purpose of this program to begin to establish domestic sources of pertinent equipments for x-ray lithography and to demonstrate their use in fabricating devices with 0.25 micrometer features.

The technical challenges may be considered to fall into four general areas: x-ray sources, the masks which define the pattern for the semiconductor wafer, the alignment equipment which positions the masks relative to the wafer during exposure,

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and the associated device processing which forms the completed integrated circuit structure. DoD would also work closely with the proposed SEMATECH Lithography Advisory Committee, to ensure a proper direction toward semiconductor production.

In summary, X-RAY lithography appears to be the leading lithographic approach for the most advanced semiconductor production in the late 1990s. Much development remains to be done before this technology is production ready.

Thank you and I will be happy to respond to any questions you may have.

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